

SEQUENCE LISTING

<110> Heinz, Ernst
Girke, Thomas
Scheffler, Jodi
Da Costa e Silva, Oswaldo

<120> Plants expressing $\Delta 6$ -desaturase genes, PUFAS-containg oils from these plants, and a process for the preparation of unsaturated fatty acids

<130> 0093/000032
<140> US 10/019,048
<141> Filing date not yet granted

<150> PCT/EP00/006223
<151> 2000-07-04

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<170> WordPerfect version 6.1

<210> 1

<211> 2012

<212> DNA

<213> *Physcomitrella patens*

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<221> CDS

<222> (319)..(1896)

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ggagactgtt gattttatgt cgggggcatt gccattgtgg agagcggggg agactcagga 240
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Met	Val	Phe	Ala	Gly	Gly	Gly	Gly	Leu	Gln	Gln	Gly						
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tct	ctc	gaa	gaa	aac	atc	gac	gtc	gag	cac	att	gcc	agt	atg	tct	ctc	399	
Ser	Leu	Glu	Glu	Asn	Ile	Asp	Val	Glu	His	Ile	Ala	Ser	Met	Ser	Leu		
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ttc	agc	gac	ttc	ttc	agt	tat	gtg	tct	tca	act	gtt	ggt	tcg	tgg	agc	447	
Phe	Ser	Asp	Phe	Phe	Ser	Tyr	Val	Ser	Ser	Thr	Val	Gly	Ser	Trp	Ser		
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gta	cac	agt	ata	caa	cct	ttg	aag	cgc	ctg	acg	agt	aag	cgt	gtt	495		
Val	His	Ser	Ile	Gln	Pro	Leu	Lys	Arg	Leu	Thr	Ser	Lys	Lys	Arg	Val		
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Ser	Glu	Ser	Ala	Ala	Val	Gln	Ile	Ser	Ala	Glu	Val	Gln	Arg	Asn			
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Ser	Ser	Thr	Gln	Gly	Thr	Ala	Glu	Ala	Leu	Ala	Glu	Ser	Val	Val	Lys		
80								85				90					
ccc	acg	aga	cga	agg	tca	tct	cag	tgg	aag	tcg	aca	cac	ccc	cta	639		
Pro	Thr	Arg	Arg	Arg	Ser	Ser	Gln	Trp	Lys	Lys	Ser	Thr	His	Pro	Leu		
95								100				105					
tca	gaa	gta	gca	gta	cac	aac	aag	cca	agc	gat	tgc	tgg	att	gtt	gta	687	
Ser	Glu	Val	Ala	Val	His	Asn	Lys	Pro	Ser	Asp	Cys	Trp	Ile	Val	Val		
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Lys	Asn	Lys	Val	Ile	Ser	Tyr	Asp	Val	Ser	Asn	Phe	Ala	Asp	Glu	His	Pro	Gly
125								130				135					
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Gly	Ser	Val	Ile	Ser	Thr	Tyr	Phe	Gly	Arg	Asp	Gly	Thr	Asp	Val	Phe		
140								145				150			155		
tct	agt	ttt	cat	gca	gct	tct	aca	tgg	aaa	att	ctt	caa	gac	ttt	tac	831	
Ser	Ser	Phe	His	Ala	Ala	Ser	Thr	Trp	Lys	Ile	Leu	Gln	Asp	Phe	Tyr		
160								165				170					
att	ggt	gac	gtg	gag	agg	gtg	gag	ccg	act	cca	gag	ctg	ctg	aaa	gat	879	
Ile	Gly	Asp	Val	Glu	Arg	Val	Glu	Pro	Thr	Pro	Glu	Leu	Leu	Lys	Asp		
175								180				185					
ttc	cga	gaa	atg	aga	gct	ctt	ttc	ctg	agg	gag	caa	ctt	ttc	aaa	agt	927	
Phe	Arg	Glu	Met	Arg	Ala	Leu	Phe	Leu	Arg	Glu	Gln	Leu	Phe	Lys	Ser		
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tcg aaa ttg tac tat gtt atg aag ctg ctc acg aat gtt gct att ttt			975
Ser Lys Leu Tyr Tyr Val Met Lys Leu Leu Thr Asn Val Ala Ile Phe			
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gct gcg agc att gca ata ata tgt tgg agc aag act att tca gcg gtt			1023
Ala Ala Ser Ile Ala Ile Ile Cys Trp Ser Lys Thr Ile Ser Ala Val			
220	225	230	235
ttg gct tca gct tgt atg atg gct ctg tgt ttc caa cag tgc gga tgg			1071
Leu Ala Ser Ala Cys Met Met Ala Leu Cys Phe Gln Gln Cys Gly Trp			
240	245	250	
cta tcc cat gat ttt ctc cac aat cag gtg ttt gag aca cgc tgg ctt			1119
Leu Ser His Asp Phe Leu His Asn Gln Val Phe Glu Thr Arg Trp Leu			
255	260	265	
aat gaa gtt gtc ggg tat gtg atc ggc aac gcc gtt ctg ggg ttt agt			1167
Asn Glu Val Val Gly Tyr Val Ile Gly Asn Ala Val Leu Gly Phe Ser			
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Thr Gly Trp Trp Lys Glu Lys His Asn Leu His His Ala Ala Pro Asn			
285	290	295	
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Glu Cys Asp Gln Thr Tyr Gln Pro Ile Asp Glu Asp Ile Asp Thr Leu			
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ccc ctc att gcc tgg agc aag gac ata ctg gcc aca gtt gag aat aag			1311
Pro Leu Ile Ala Trp Ser Lys Asp Ile Leu Ala Thr Val Glu Asn Lys			
320	325	330	
aca ttc ttg cga atc ctc caa tac cag cat ctg ttc ttc atg ggt ctg			1359
Thr Phe Leu Arg Ile Leu Gln Tyr Gln His Leu Phe Phe Met Gly Leu			
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Leu Phe Phe Ala Arg Gly Ser Trp Leu Phe Trp Ser Trp Arg Tyr Thr			
350	355	360	
tct aca gca gtg ctc tca cct gtc gac agg ttg ttg gag aag gga act			1455
Ser Thr Ala Val Leu Ser Pro Val Asp Arg Leu Leu Glu Lys Gly Thr			
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Val Leu Phe His Tyr Phe Trp Phe Val Gly Thr Ala Cys Tyr Leu Leu			
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cct ggt tgg aag cca tta gta tgg atg gcg gtg act gag ctc atg tcc			1551
Pro Gly Trp Lys Pro Leu Val Trp Met Ala Val Thr Glu Leu Met Ser			
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Gly Met Leu Leu Gly Phe Val Phe Val Leu Ser His Asn Gly Met Glu			
415	420	425	
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Val Tyr Asn Ser Ser Lys Glu Phe Val Ser Ala Gln Ile Val Ser Thr			
430	435	440	
cgg gat atc aaa gga aac ata ttc aac gac tgg ttc act ggt ggc ctt			1695
Arg Asp Ile Lys Gly Asn Ile Phe Asn Asp Trp Phe Thr Gly Gly Leu			
445	450	455	
aac agg caa ata gag cat cat ctt ttc cca aca atg ccc agg cat aat			1743
Asn Arg Gln Ile Glu His His Leu Phe Pro Thr Met Pro Arg His Asn			
460	465	470	475
tta aac aaa ata gca cct aga gtg gag gtg ttc tgt aag aaa cac ggt			1791
Leu Asn Lys Ile Ala Pro Arg Val Glu Val Phe Cys Lys Lys His Gly			
480	485	490	
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Leu Val Tyr Glu Asp Val Ser Ile Ala Thr Gly Thr Cys Lys Val Leu			
495	500	505	
aaa gca ttg aag gaa gtc gcg gag gct gcg gca gag cag cat gct acc			1887
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<213> *Physcomitrella patens*

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Val Gln Cys Ile Ser Ala Glu Val Gln Arg Asn Ser Ser Thr Gln Gly
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Thr Ala Glu Ala Leu Ala Glu Ser Val Val Lys Pro Thr Arg Arg Arg
85 90 95

Ser Ser Gln Trp Lys Lys Ser Thr His Pro Leu Ser Glu Val Ala Val
100 105 110

His Asn Lys Pro Ser Asp Cys Trp Ile Val Val Lys Asn Lys Val Tyr
115 120 125

Asp Val Ser Asn Phe Ala Asp Glu His Pro Gly Gly Ser Val Ile Ser
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Thr Tyr Phe Gly Arg Asp Gly Thr Asp Val Phe Ser Ser Phe His Ala
145 150 155 160

Ala Ser Thr Trp Lys Ile Leu Gln Asp Phe Tyr Ile Gly Asp Val Glu
165 170 175

Arg Val Glu Pro Thr Pro Glu Leu Leu Lys Asp Phe Arg Glu Met Arg
180 185 190

Ala Leu Phe Leu Arg Glu Gln Leu Phe Lys Ser Ser Lys Leu Tyr Tyr
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Val Met Lys Leu Leu Thr Asn Val Ala Ile Phe Ala Ala Ser Ile Ala
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Ile Ile Cys Trp Ser Lys Thr Ile Ser Ala Val Leu Ala Ser Ala Cys
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260 265 270

Tyr Val Ile Gly Asn Ala Val Leu Gly Phe Ser Thr Gly Trp Trp Lys
275 280 285

Glu Lys His Asn Leu His His Ala Ala Pro Asn Glu Cys Asp Gln Thr
290 295 300

Tyr Gln Pro Ile Asp Glu Asp Ile Asp Thr Leu Pro Leu Ile Ala Trp
305 310 315 320

Ser Lys Asp Ile Leu Ala Thr Val Glu Asn Lys Thr Phe Leu Arg Ile
325 330 335

Leu Gln Tyr Gln His Leu Phe Phe Met Gly Leu Leu Phe Phe Ala Arg
340 345 350

Gly Ser Trp Leu Phe Trp Ser Trp Arg Tyr Thr Ser Thr Ala Val Leu
355 360 365

Ser Pro Val Asp Arg Leu Leu Glu Lys Gly Thr Val Leu Phe His Tyr
370 375 380

Phe Trp Phe Val Gly Thr Ala Cys Tyr Leu Leu Pro Gly Trp Lys Pro
385 390 395 400

Leu Val Trp Met Ala Val Thr Glu Leu Met Ser Gly Met Leu Leu Gly
405 410 415

Phe Val Phe Val Leu Ser His Asn Gly Met Glu Val Tyr Asn Ser Ser
420 425 430

Lys Glu Phe Val Ser Ala Gln Ile Val Ser Thr Arg Asp Ile Lys Gly
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Asn Ile Phe Asn Asp Trp Phe Thr Gly Leu Asn Arg Gln Ile Glu
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His His Leu Phe Pro Thr Met Pro Arg His Asn Leu Asn Lys Ile Ala
465 470 475 480

Pro Arg Val Glu Val Phe Cys Lys Lys His Gly Leu Val Tyr Glu Asp
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SEQUENCE PROTOCOL

<170> PatentIn Vers. 2.0

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<211> 2012

<212> DNA

<213> *Physcomitrella patens*

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<222> (319)..(1896)

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 tgtggagcg 351
 cttttggaa atg gta ttc gca ggc ggt gga ctt cag cag ggc
 Met Val Phe Ala Gly Gly Gly Leu Gln Gln Gly
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tct ctc gaa gaa aac atc gac gtc gag cac att gcc agt atg tct ctc 399
 Ser Leu Glu Glu Asn Ile Asp Val Glu His Ile Ala Ser Met Ser Leu
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ttc agc gac ttc ttc agt tat gtg tct tca act gtt ggt tcg tgg agc 447
 Phe Ser Asp Phe Ser Tyr Val Ser Ser Thr Val Gly Ser Trp Ser
 30 35 40

gta cac agt ata caa cct ttg aag cgc ctg acg agt aag aag cgt gtt 495
 Val His Ser Ile Gln Pro Leu Lys Arg Leu Thr Ser Lys Lys Arg Val
 45 50 55

tcg gaa agc gct gcc gtg caa tgt ata tca gct gaa gtt cag aga aat 543
 Ser Glu Ser Ala Ala Val Gln Cys Ile Ser Ala Glu Val Gln Arg Asn
 60 65 70 75

tcg agt acc cag gga act gcg gag gca ctc gca gaa tca gtc gtg aag 591
 Ser Ser Thr Gln Gly Thr Ala Glu Ala Glu Ser Val Val Lys
 80 85 90

ccc acg aga cga agg tca tct cag tgg aag aag tcg aca cac ccc cta 639
 Pro Thr Arg Arg Ser Ser Gln Trp Lys Lys Ser Thr His Pro Leu
 95 100 105

tca gaa gta gca gta cac aac aag cca agc gat tgc tgg att gtt gta	687		
Ser Glu Val Ala Val His Asn Lys Pro Ser Asp Cys Trp Ile Val Val			
110	115	120	
aaa aac aag gtg tat gat gtt tcc aat ttt gcg gac gag cat ccc gga	735		
Lys Asn Lys Val Tyr Asp Val Ser Asn Phe Ala Asp Glu His Pro Gly			
125	130	135	
gga tca gtt att agt act tat ttt gga cga gac ggc aca gat gtt ttc	783		
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140	145	150	155
tct agt ttt cat gca gct tct aca tgg aaa att ctt caa gac ttt tac	831		
Ser Ser Phe His Ala Ala Ser Thr Trp Lys Ile Leu Gln Asp Phe Tyr			
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Phe Arg Glu Met Arg Ala Leu Phe Leu Arg Glu Gln Leu Phe Lys Ser			
190	195	200	
tcg aaa ttg tac tat gtt atg aag ctg ctc acg aat gtt gct att ttt	975		
Ser Lys Leu Tyr Tyr Val Met Lys Leu Leu Thr Asn Val Ala Ile Phe			
205	210	215	
gct gcg agc att gca ata ata tgt tgg agc aag act att tca gcg gtt	1023		
Ala Ala Ser Ile Ala Ile Ile Cys Trp Ser Lys Thr Ile Ser Ala Val			
220	225	230	235
ttg gct tca gct tgt atg atg gct ctg tgt ttc caa cag tgc gga tgg	1071		
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240	245	250	
cta tcc cat gat ttt ctc cac aat cag gtg ttt gag aca cgc tgg ctt	1119		
Leu Ser His Asp Phe Leu His Asn Gln Val Phe Glu Thr Arg Trp Leu			
255	260	265	
aat gaa gtt gtc ggg tat gtg atc ggc aac gcc gtt ctg ggg ttt agt	1167		
Asn Glu Val Val Gly Tyr Val Ile Gly Asn Ala Val Leu Gly Phe Ser			
270	275	280	
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Thr Gly Trp Trp Lys Glu Lys His Asn Leu His His Ala Ala Pro Asn			
285	290	295	
gaa tgc gat cag act tac caa cca att gat gaa gat att gat act ctc	1263		
Glu Cys Asp Gln Thr Tyr Gln Pro Ile Asp Glu Asp Ile Asp Thr Leu			

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320			325	330
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Thr	Phe	Leu	Arg	Ile Leu Gln Tyr Gln His Leu Phe Phe Met Gly Leu
335			340	345
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Leu	Phe	Phe	Ala	Arg Gly Ser Trp Leu Phe Trp Ser Trp Arg Tyr Thr
350			355	360
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Ser	Thr	Ala	Val	Leu Ser Pro Val Asp Arg Leu Leu Glu Lys Gly Thr
365			370	375
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Val	Leu	Phe	His	Tyr Phe Trp Phe Val Gly Thr Ala Cys Tyr Leu Leu
380			385	395
cct ggt tgg aag cca tta gta tgg atg gcg gtg act gag ctc atg tcc				1551
Pro	Gly	Trp	Lys	Pro Leu Val Trp Met Ala Val Thr Glu Leu Met Ser
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ggc atg ctg ctg ggc ttt gta ttt gta ctt agc cac aat ggg atg gag				1599
Gly	Met	Leu	Leu	Gly Phe Val Phe Val Leu Ser His Asn Gly Met Glu
415			420	425
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Val	Tyr	Asn	Ser	Ser Lys Glu Phe Val Ser Ala Gln Ile Val Ser Thr
430			435	440
cgg gat atc aaa gga aac ata ttc aac gac tgg ttc act ggt ggc ctt				1695
Arg	Asp	Ile	Lys	Gly Asn Ile Phe Asn Asp Trp Phe Thr Gly Gly Leu
445			450	455
aac agg caa ata gag cat cat ctt ttc cca aca atg ccc agg cat aat				1743
Asn	Arg	Gln	Ile	Glu His His Leu Phe Pro Thr Met Pro Arg His Asn
460			465	475
tta aac aaa ata gca cct aga gtg gag gtg ttc tgt aag aaa cac ggt				1791
Leu	Asn	Lys	Ile	Ala Pro Arg Val Glu Val Phe Cys Lys Lys His Gly
480			485	490
ctg gtg tac gaa gac gta tct att gct acc ggc act tgc aag gtt ttg				1839
Leu	Val	Tyr	Glu	Asp Val Ser Ile Ala Thr Gly Thr Cys Lys Val Leu
495			500	505
aaa gca ttg aag gaa gtc gcg gag gct gcg gca gag cag cat gct acc				1887

Lys Ala Leu Lys Glu Val Ala Glu Ala Ala Ala Glu Gln His Ala Thr
 510 515 520

acc agt taa cagtcttgg aaagcttggc aattgatctt tattctccac 1936
 Thr Ser
 525

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 <212> PRT
 <213> *Physcomitrella patens*

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 35 40 45

Pro Leu Lys Arg Leu Thr Ser Lys Lys Arg Val Ser Glu Ser Ala Ala
 50 55 60

Val Gln Cys Ile Ser Ala Glu Val Gln Arg Asn Ser Ser Thr Gln Gly
 65 70 75 80

Thr Ala Glu Ala Leu Ala Glu Ser Val Val Lys Pro Thr Arg Arg Arg
 85 90 95

Ser Ser Gln Trp Lys Lys Ser Thr His Pro Leu Ser Glu Val Ala Val
 100 105 110

His Asn Lys Pro Ser Asp Cys Trp Ile Val Val Lys Asn Lys Val Tyr
 115 120 125

Asp Val Ser Asn Phe Ala Asp Glu His Pro Gly Gly Ser Val Ile Ser
 130 135 140

Thr Tyr Phe Gly Arg Asp Gly Thr Asp Val Phe Ser Ser Phe His Ala
 145 150 155 160

Ala Ser Thr Trp Lys Ile Leu Gln Asp Phe Tyr Ile Gly Asp Val Glu
 165 170 175

Arg Val Glu Pro Thr Pro Glu Leu Leu Lys Asp Phe Arg Glu Met Arg
 180 185 190

Ala Leu Phe Leu Arg Glu Gln Leu Phe Lys Ser Ser Lys Leu Tyr Tyr
 195 200 205

Val Met Lys Leu Leu Thr Asn Val Ala Ile Phe Ala Ala Ser Ile Ala
 210 215 220

Ile Ile Cys Trp Ser Lys Thr Ile Ser Ala Val Leu Ala Ser Ala Cys
 225 230 235 240

Met Met Ala Leu Cys Phe Gln Gln Cys Gly Trp Leu Ser His Asp Phe
 245 250 255

Leu His Asn Gln Val Phe Glu Thr Arg Trp Leu Asn Glu Val Val Gly
 260 265 270

Tyr Val Ile Gly Asn Ala Val Leu Gly Phe Ser Thr Gly Trp Trp Lys
 275 280 285

Glu Lys His Asn Leu His His Ala Ala Pro Asn Glu Cys Asp Gln Thr
 290 295 300

Tyr Gln Pro Ile Asp Glu Asp Ile Asp Thr Leu Pro Leu Ile Ala Trp
 305 310 315 320

Ser Lys Asp Ile Leu Ala Thr Val Glu Asn Lys Thr Phe Leu Arg Ile
 325 330 335

Leu Gln Tyr Gln His Leu Phe Phe Met Gly Leu Leu Phe Phe Ala Arg
 340 345 350

Gly Ser Trp Leu Phe Trp Ser Trp Arg Tyr Thr Ser Thr Ala Val Leu
 355 360 365

Ser Pro Val Asp Arg Leu Leu Glu Lys Gly Thr Val Leu Phe His Tyr
 370 375 380

Phe Trp Phe Val Gly Thr Ala Cys Tyr Leu Leu Pro Gly Trp Lys Pro
 385 390 395 400

Leu Val Trp Met Ala Val Thr Glu Leu Met Ser Gly Met Leu Leu Gly
 405 410 415

Phe Val Phe Val Leu Ser His Asn Gly Met Glu Val Tyr Asn Ser Ser
 420 425 430

Lys Glu Phe Val Ser Ala Gln Ile Val Ser Thr Arg Asp Ile Lys Gly
 435 440 445

Asn Ile Phe Asn Asp Trp Phe Thr Gly Gly Leu Asn Arg Gln Ile Glu
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His His Leu Phe Pro Thr Met Pro Arg His Asn Leu Asn Lys Ile Ala
465 470 475 480

Pro Arg Val Glu Val Phe Cys Lys Lys His Gly Leu Val Tyr Glu Asp
485 490 495

Val Ser Ile Ala Thr Gly Thr Cys Lys Val Leu Lys Ala Leu Lys Glu
500 505 510

Val Ala Glu Ala Ala Ala Glu Gln His Ala Thr Thr Ser
515 520 525